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Description

Method and network node for path searching in a packet-
switching communication network

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The invention relates to a method according to the preamble of
claim 1 and a network node according to the preamble of claim
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10   Packet-switching communication networks, for example an
internet protocol network or IP network, transmit electronic
data in the form of packets or pulse frames from a source
network node to a destination network node via different
intermediate network nodes of the communication network. Any
15   network node of the communication network can assume the role
of source network node or destination node for data packets.
The network nodes are connected together by means of
connections or connection paths or links. At least one network
node address, e.g. an IP address, is assigned to each of these
20   network nodes, such as routers, switches, gateways, bridges,
network elements, etc.

The network node addresses, topology information and further
data are distributed via routing protocols, such as OSPF, RIP,
25.   BGP, IS-IS, etc., to the network nodes of the communication
network. The information is transmitted with the aid of so-
called Protocol Data Units or PDUs. As a function of the
routing protocol, the PDUs contain information about their own
network nodes and the adjacent network nodes linked thereto. In
30   this manner every network node has information about the
network nodes contained in the communication network and their
adjacent nodes, such that any network node can or could create
a network plan of the communication network therefrom. By

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evaluating and storing the information contained in the routing protocol PDUs or the established network view, any network node is able, on the basis of known protocols or algorithms, to calculate and store routes respectively to all the network

5   nodes of the communication network. Routing protocols, such as OSPF and IS-IS, thereby have two main functions:

1. Protocol for identifying topology or for collating the information required for path searching.

10 2. Path searching and mapping the selected paths in a routing table, forwarding look-up table, forwarding information base or control table of the network node.

An algorithm for calculating routes or paths to a network node

15 in a network is for example the shortest path search method, used in the OSPF and IS-IS routing protocols. To compensate for its limitations in respect of so-called quality of service or QoS and availability, extended path searches have also been proposed, such as multipath routing. The so-called equal cost

20 multiple path routing method or ECMP is one type of multipath routing.

One of the available path search methods results in a better solution depending on the network topology.

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The routes, paths or routing paths to a destination network node or to a destination system linked to a network node, as established by an algorithm implemented in the network node, are thereby stored in a so-called routing table, forwarding

30 look-up table, control table or forwarding information base of the network node. This contains the network node address of the destination network node or destination system, the network

node address of the adjacent network node leading to this
destination and further information.

Incoming data packets with a destination network node address
5   can be forwarded to the destination network node on the basis
of the routing table. The destination network node address is
thereby compared with the entries in the routing table and in
the event of correspondence the adjacent network node and
interface are established, via which the packet is transmitted
10   to the destination network node.

To create its routing table or forwarding look-up table,
according to which the next hop is defined for each packet for
data packet forwarding, a modern router can use results from
15   the routing information evaluated by means of the algorithm and
by means of manually configured static routes.

The object of the present invention is to improve the manner in
which a routing path is found in a network node of a packet-
20   switching communication network.

This object is achieved by a method with the features of claim
1 and by a network node with the features of claim 5.

25   By using at least two or more path search methods to a network
node or destination system of the communication network it is
possible to combine different path search strategies, tailored
in an optimum manner to the network topology, at the same time
as "path search building blocks" in a network node or network.
30   This has the advantage of allowing routing path management that
is optimally tailored to the topology. Also the limitations of
a generally good path search method can be compensated for by
combining it with a specific path search method.

Advantageous developments of the invention are specified in the subclaims.

Use of a multipath search method and a shortest path search
5   method or algorithm in a network node of a communication network has the advantage that new path search strategies can be introduced in communication networks that are not fully multipath-capable. For example when a multipath routing method is introduced with a requirement of at least two disjunctive
10   routing paths, a network may have topological restrictions, which prevent continuous multipath routing with two routes. It is then possible to combine the multipath method with the shortest path method here, while this situation continues.

15   An exemplary embodiment of the invention is illustrated in the drawing and described below.

In the drawing:

20   Figure 1   shows a section from a network node for the use of the claimed method.

Figure 2   shows a variant of a network node according to figure 1.
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Figure 1 shows a section from a network node, which is operated in a communication network comprising a number of network nodes. It shows a protocol evaluation arrangement P, which receives routing protocol PDUs from other network nodes and
30   evaluates them. The protocol evaluation arrangement P feeds the received information to a path search arrangement WSE, which splits this information and feeds it to a number of path search methods WS1, …, WSn. The path search methods WS1, …, WSn each

use different algorithms or take different algorithms as a
basis to establish different paths to the network nodes,
destination network nodes or destination systems of the
communication network linked to the network nodes. For example

5   the first path search method WS1 uses a shortest path
algorithm, such as the Dijkstra algorithm, to establish the
shortest path to the respective network node. The second path
search method WS2 uses a multipath algorithm to establish a set
of paths to a respective network node. A third path search

10   method WS3 uses a further algorithm, such as the Bellman Ford
algorithm, to establish the most economical, most fail-safe or
most effective path to a network node. Further path search
methods similarly establish routing paths to network nodes
according to predefined basic conditions or algorithms. The

15   routing paths established by the path search methods WS1, …,
WSn are fed to a discriminator E, which selects one routing
path to a network node respectively that is optimal for the
network node in the respective network topology or satisfies
corresponding criteria from the established routing paths. The

20   selected routing path to a destination network node is fed by
the discriminator E to a forwarding information base FIB or
routing table or control table, which inputs it into a table or
database. A routing arrangement RE forwards or routes data
packets based on the forwarding information base FIB. In this

25   process the routing arrangement RE first establishes the
destination address of a received data packet. This destination
address is transmitted from the routing arrangement RE to the
forwarding information base FIB. The destination address is
compared with stored values to establish the output or

30   interface, port or adjacent network node, to which the packet
must be sent to reach the destination address. This information
is transmitted from the forwarding information base FIB to the

routing arrangement RE, which then forwards the data packet to
the corresponding network node.

In one embodiment of the invention the routing paths or routes
5   established by means of the different path search methods are
input jointly in the forwarding information base FIB so that a
number of routes, established by means of different methods,
are input in parallel in the forwarding information base FIB
and are jointly active.

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The path search method to be used in the respective situation
can also be selected according to a wide range of criteria.
This does not mean that a number of path search methods run at
the same time but that a specific path search method is used
15   for a specific network node or for a specific destination
network node. Thus a suitable method for establishing routing
paths can be selected based on the characteristics of the
network node. Also a suitable method for establishing routing
paths to a destination network node can be selected and used
20   based on the characteristics of said destination network node.

A multipath routing method can be used in one part of the
communication network and a shortest path search method can be
used in another part of the communication network. Other
25   topological criteria can also be used for the path search.
Routing paths can be established by means of path search
methods or corresponding algorithms according to different
criteria such as cost, redundancy requirements or quality.

30   Figure 2 shows a section from a network node according to
figure 1, with the difference that the information fed from the
protocol evaluation arrangement P to the path search
arrangement WSE leads in the path search arrangement WSE via a

first switching device S1 to one of a number of possible path search methods WS1, …, WSn. The outputs of the path search methods WS1, …, WSn are connected via a second switching device S2 to the input of the forwarding information base FIB. The two

5 switching devices S1 and S2 are controlled in parallel by the discriminator E such that the information from the protocol evaluation arrangement P is fed respectively to a "selected" path search method and the routing paths established by means of the selected path search methods are fed to the forwarding

10 information base FIB.

In this instance the automatically or manually controlled discriminator E selects one of a number of path search methods or algorithms implemented in the network node to find the routing path for the network node.

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In one embodiment each network node first establishes the network structure based on the topology information exchanged between the network nodes by means of routing protocols and analyzes it. They then assign a corresponding path search

20 method to specific destination nodes, network segments, lines or address areas according to predefined criteria. The results of the path search are then input in the forwarding information base FIB or routing table.

25 The discriminator for the optimum path search method can:

- be controlled manually by an external management system, in that it is predefined for every network node which path search method or path search result it should use,

30 - select a path search method automatically according to predefined features or basic conditions,

- use the results of a path search according to predefined topological features or points of view,

- use a specific path search method or the results of a specific path search method/algorithm for each destination
5   network node or

- select according to different criteria.

The core of the invention is that a network node can establish routing paths according to a number of path search methods or
10 algorithms. This can be done by establishing a number of routing paths in parallel from the exchanged topology information of a routing protocol by means of a number of algorithms or path search methods. This takes place irrespective of the routing protocol used and the path search
15 methods assigned to said protocol. This means that irrespective of the routing protocol used, e.g. OSPF, RIP, IS-IS, BGP, a number of routing paths are established according to different algorithms. Only the topology information of the routing protocol used is deployed. A discriminator controlled by means
20 of specific criteria then establishes the routing paths suitable for the respective purpose. A number of routing paths, such as backup routing paths, can hereby also be input in the forwarding information base FIB.

25 A specific path search method or algorithm from a number of available methods or algorithms can also establish the routing paths to a destination network node for a network node as a function of the discriminator.